Marine pollution by plastics and microplastics: An emerging threat to public health

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- Final degree project -

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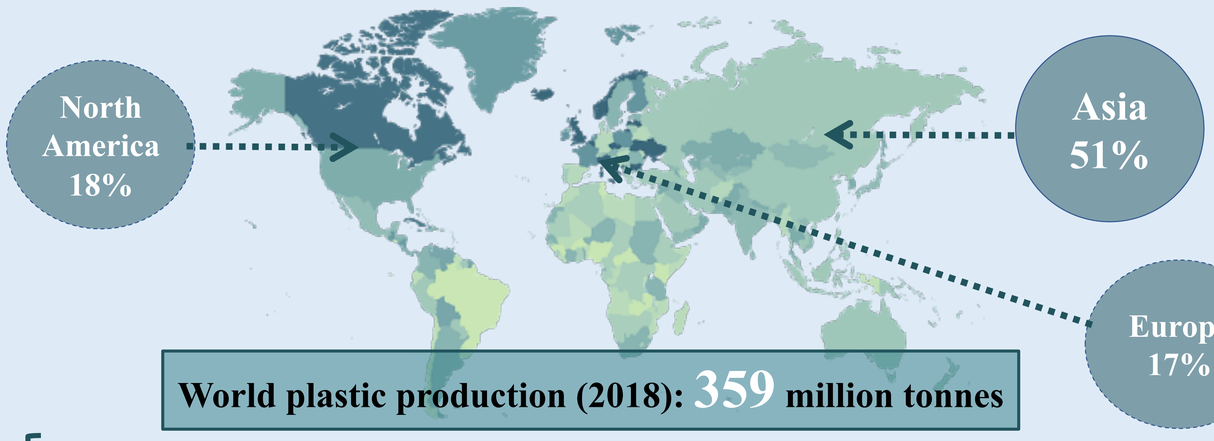
1. INTRODUCTION

The massive production of plastics began in 1940 and, since then, the dependence of these polymers by consumers is unquestionable. We produce around 350 million tones/year, of which 4.9 billions were found in the environment in 2015 and it is estimated that in 2050 will be 12 billion tones.



World plastic production (2018): 359 million tonnes

Durability
Resistance
Recycling rate
↓ Mismanagement
Maritime use

Consequences

A significant portion of plastics is introduced and persist in the marine ecosystem

OBJECTIVES: (1) Critically evaluate the available information on microplastics in the marine environment and its potential impact on human health; (2) Review the spatial and temporal evolution of marine environmental microplastics; (3) Describe the biological and ecological impacts of microplastics on marine organisms.

2. TYPES OF MICROPLASTICS

Definition: Plastic pieces of < 5 mm. Its origin can be:
- 1ary: Manufactured to be with this certain size.
- 2ary: From the fragmentation of macroplastics.

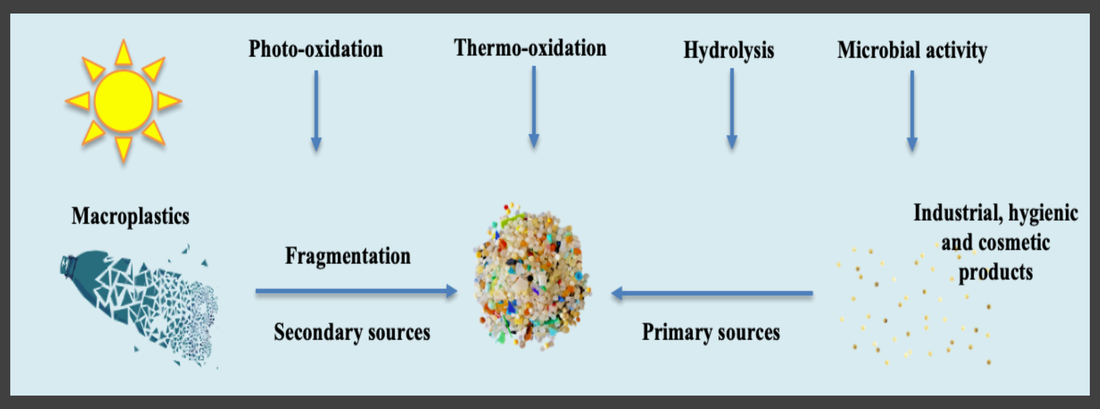


Figure 1: Degradation route from plastics to microplastics.

3. DISTRIBUTION

Table 1: Results of the total microplastic particle count (n x10^{10} particles) and their weight (g x 10^2 tonnes) in oceans around the world.

	NP	NA	SP	SA	IO	MED	Total
Particles (0.33 - > 200 mm)	199.0	93.0	49.1	29.7	130.0	24.7	525.5
%	37.9	17.7	9.3	5.6	24.7	4.7	
Weight (0.33 - > 200 mm)	964.0	564.7	210.2	127.8	591.3	231.5	2689.5
%	35.8	21.0	7.8	4.7	22.0	8.6	

Note: NP: North Pacific, NA: North Atlantic, SP: South Pacific, SA: South Atlantic, IO: Indic Ocean and MED: Mediterranean Sea. Adapted table from "More than 5 Trillion Plastic Pieces Weighing Over 250,000 Tons of Afloat at Sea" by Eriksen M et al., 2014.

- **Similar abundance between Northern and Southern hemisphere, where its production and consumption of plastic or population density is lower.**
- **In the north is found the "North Pacific Central Turn", the most famous plastic accumulation, also called the "Plastic Continent".**
- **The Mediterranean Sea has been proposed as the sixth larger microplastic accumulation zone.**

4. IMPACTS IN MARINE WILDLIFE

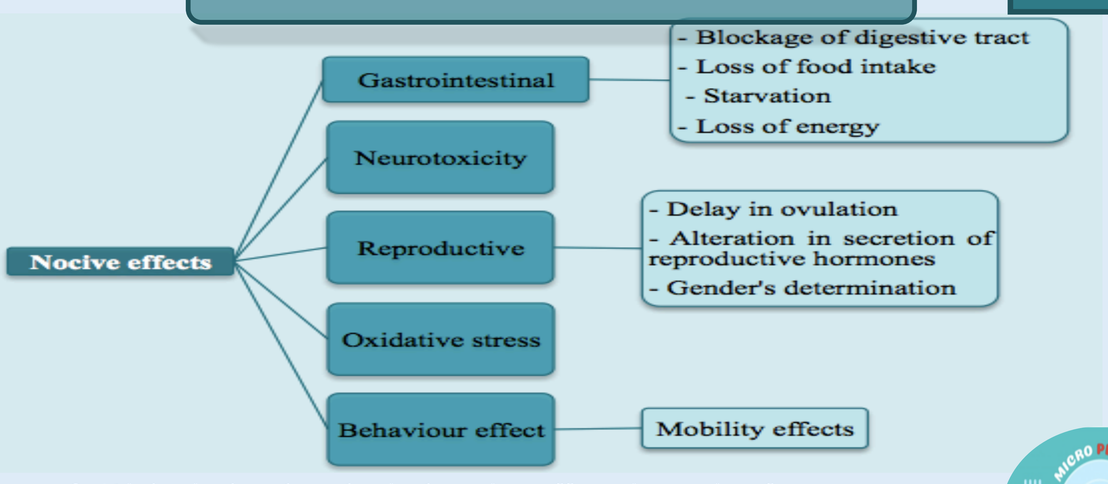


Figure 2: Biological and ecological nocive effects in marine fauna. Adapted from "Marine microplastics spell big problems for future generations" by Galloway T & Lewis C, 2016

5. THREATS TO PUBLIC HEALTH

Microplastics (MPs) are ingested by various commercial marine species, as well as mussels, oysters, crabs and fish.
Sea products consumed with their full digestive tract, such as bivalves and filtering organisms, are the main potential sources of microplastics for humans from marine foods.

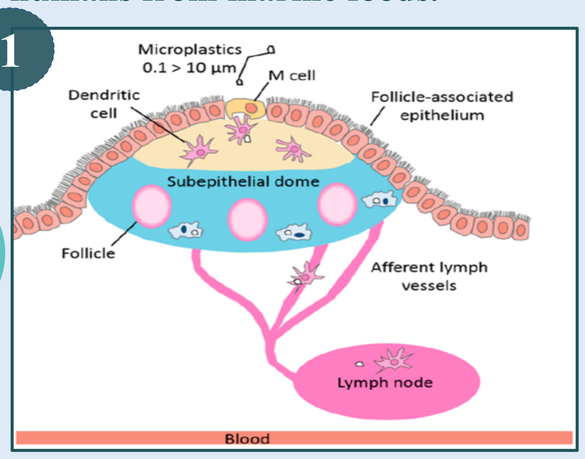


Figure 3: Predicted pathways of microplastic uptake from GIT. Figure from "Plastic and Human Health: A Micro Issue?" by Wright S & Kelly F, 2017.

1) Endocytosis by M cells of the Peyer's patches: M cells capture and transport microplastics and particles from the intestinal lumen to the mucosal lymphoid tissues.

≤ 150 µm ! **≤ 20 µm**

2) Paracellular persorption: Microplastics can cross the junctions of the epithelial layer. Dendritic cells are able to phagocytose this particles, moving them to the underlying lymphatic vessels and veins, so they can reach secondary tissues.

≤0.3% of absorption

6. CONCLUSIONS

- % of MPs similar in northern and southern hemisphere, despite the last one having lower population density. Mediterranean Sea is described as the 6th largest accumulation of MPs.
- The adverse effects of MPs on marine biota are difficult to perceive. Despite knowing some of these, from digestive to reproductive and neurological problems, much research is still needed to better understand them.
- Humans are vulnerable to the exposure of MPs, especially, through seafood consumption. It has been shown that its absorption might be very low. However, information on the occurrence of MPs in these products is scarce, exposure levels are generally unknown and the potential effects on consumers are not yet well understood.
Therefore, more reviews and detailed research on this topic should be published so that people can be aware of this threat.

References

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